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Effects of caffeine on persuasion and attitude change: The role of secondary tasks in manipulating systematic message processing.

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Abstract

Two experiments are reported that examine the effects of caffeine consumption on attitude change by using different secondary tasks to manipulate message processing. The first experiment employed an orientating task while the second experiment employed a distracter task. In both experiments participants consumed an orange-juice drink that either contained caffeine (3.5mg/kg body weight) or did not contain caffeine (placebo) prior to reading a counter-attitudinal communication. The results across both experiments were similar. When message processing was reduced or under high distraction, there was no attitude change irrespective of caffeine consumption. However, when message processing was enhanced or under low distraction, there was greater attitude change in the caffeine vs. placebo conditions. Furthermore, attitudes formed after caffeine consumption resisted counter-persuasion (Experiment 1) and led to indirect attitude change (Experiment 2). The extent that participants engaged in message-congruent thinking mediated the amount of attitude change. These results provide evidence that moderate amounts of caffeine increase systematic processing of the arguments in the message resulting in greater agreement.

Introduction

Caffeine (1, 3, 7 – trimethylxanthine) is a natural constituent of numerous and readily available foods and beverages (Lieberman, 2003), and is believed to be the most widely and frequently consumed psychoactive substance in the world (James, 1997). As many as 80% of Americans are reported to be regular 'moderate' caffeine users, consuming, on average approximately 200 mg/day. (Barone & Roberts, 1984; Hughes & Oliveto,1997). Similar levels of consumption have been reported in Australia (232 mg/day) (Fredholm, Bättig, Holmen, Nehlig, & Zvartau, 1999) and the UK (220 mg/day) where about 95% of the population consumes caffeinated beverages at least once a week (Brice & Smith, 2002a). The majority of this caffeine intake is from drinking coffee, although amongst teenagers, consumption of cola soft drinks and energy drinks are now popular (Choice, 2001; Jarvis, 1993). Because of caffeine's popularity and widespread consumption it has attracted intensive investigations into its behavioural effects in humans. To date, whilst there is a large literature examining the effects of caffeine on physiological and cognitive functioning, there is surprisingly little research that focuses on the relationship between caffeine and 'social' processes. The aim of this paper is to address this issue by examining the effects of caffeine on one very important aspect of social behavior, namely persuasion and attitude change. By way of introduction, we briefly outline what caffeine is, its physiological effects on the brain and, most importantly, its impact on the cognitive processes that are relevant to persuasion. We then consider what impact caffeine might have on persuasion. It is this question that the two experiments in this paper seek to address.

The high consumption of caffeine-containing foods and beverages has been attributed to its psychoactive properties (Smith, 2002). Indeed, habitual caffeine consumers' report that it makes them feel more alert, more motivated to work and think more clearly (Avis, 1993; Rogers, Richardson & Elliman, 1995; Smith, Kendrick & Maben, 1992). Caffeine primarily achieves its arousal effects by stimulating the Central Nervous System (CNS), especially the brain (Maistro, Glalizio & Conners, 1991; Reynolds, 1996). Once ingested, caffeine is rapidly absorbed into the

blood and body tissues through the gastrointestinal tract, and quickly crosses the blood brain barrier to reach the brain where its principal action is to obstruct adenosine A_1 and A_{2a} receptors (Mycek, Harvey & Champe, 1997). The obstruction of adenosine receptors in the CNS causes secondary effects on many classes of neurotransmitters (such as, noradrenaline, dopamine, acetylcholine, serotonin, and glutamate, and GABA, Fredholm, et al., 1999), which in turn leads to an increase in CNS activity (Daly & Fredholm, 1998), especially in higher centres of the brain (Reynolds, 1996).

Of particular relevance to the present paper, is the finding that caffeine's stimulant action on the CNS increases attention at various stages of information processing (Kenemans & Lorist, 1995; Lorist, Snel & Kok, 1994). Placebo-controlled laboratory studies have shown that moderate doses of caffeine (up to 300 mg) can improve both selective attention (i.e., one source of information must be ignored while attention is focused on another), divided attention (i.e., attention must be divided among multiple and simultaneous sources of information), and sustained attention (i.e., attention needs to be constantly applied to the task); (Braun, 1998; Kerr, Sherwood & Hindmarch, 1991; Ruijter, Lorist, Snel & De Ruiter, 2000; Smit & Rogers, 2002; Van der Stelt, 1999). The beneficial effects of moderate doses of caffeine on attention have also been evident in real-life activities (Brice & Smith, 2002b; Weinberg & Bealer, 2002), with 200 mg (equivalent to 2 cups coffee) being the optimal dose and 300 mg of caffeine considered to be the peak of the 'moderate' dose range for enhancing cognitive performance (Lieberman, Tharion, Shukitt-Hale, Speckman & Tully, 2002; Tharion, Shukitt-Hale, & Lieberman, 2003). In addition to enhancing attention, moderate doses of caffeine have increased performance on more complex tasks, such as delayed or semantic memory recall (Corr, Pickering & Gray, 1995; Hasenfratz & Battig, 1994; Smith, Brice & Nguyen-van-Tam, 2001; Warburton, 1995), logical reasoning (Smith, Kendrick & Maben, 1992; Smith, Maben & Brockman, 1994), and mental arithmetic tasks (Van der Stelt, 1999). It has been suggested that caffeine improves various aspects of attention and more complex information processing, by increasing arousal (Liberman, 1992), speed (Streufert et al., 1997; Smith, 2001) and quantity (Ruijter et al., 1999) of information processed.

Given the large body of literature showing that moderate doses of caffeine benefit information processing (particularly, attention, semantic memory and logical reasoning), and that these processes are involved in persuasion, it is remarkable that only a few studies have examined the effects of caffeine consumption on persuasion. In one of the few studies in this area, Mintz and Mills (1971) asked participants to read a persuasive message about chest rays after consuming a drink that either contained caffeine (300 mg) or did not (placebo). They found that participants in the caffeine condition showed greater agreement with the message than did those in the placebo condition. Two studies by Martin, Laing, Martin and Mitchell (2005); see Martin & Martin, in press, also found evidence that moderate doses of caffeine led to greater attitude change towards a counter-attitudinal position compared to a placebo condition. Furthermore, the extent to which participants generated message-congruent thoughts after reading the message, mediated the amount of attitude change. The evidence from these studies is that caffeine encourages people to focus more attention on the content of the message and this leads to greater agreement with the message position.[1] To examine the effects of caffeine on attitude change, Martin et al., (2005) employed recent dual process models of persuasion as a guiding framework. We briefly describe this approach and how it might explain the effects of caffeine on attitude change.

Attitudes can be influenced via a number of mechanisms. The Elaboration Likelihood Model (ELM; Petty & Cacioppo, 1981) is one of the pre-eminent cognitive processing models. The ELM is based on the idea that humans want to develop correct attitudes and beliefs because they are likely to prove more functional (Petty, Cacioppo, Strathman & Priester, 1994). The ELM emphasizes two distinct avenues of persuasion – the central and peripheral routes. The central route to persuasion involves attending to (personally) relevant information while referring to previously acquired knowledge, and cultivating new meaning (Perloff, 1993). Most importantly, the individual evaluates whether the message or source has any merit (Petty et al., 1994). This route to persuasion requires systematic processing of the message, through which individuals produce greater message-relevant thoughts (Reardon, 1991). Since caffeine has the capacity to enhance information

processing, then one would expect caffeine consumption to increase the extent of systematic processing of a communication, and subsequently this should facilitate attitude change. By contrast, the peripheral route to persuasion involves relatively little cognitive effort and evaluation of the merits of the argument. Usually, a simple cue, such as source attractiveness, is sufficient to change peoples' attitudes without detailed appraisal of the content of the arguments. Thus, caffeine could increase attitude change via two routes: first via systematic processing (i.e., caffeine leads to greater elaboration of the message which leads to attitude change) or, second via a peripheral cue leading to non-systematic processing without detailed message processing (e.g., caffeine improves mood and this leads to agreement with the message).

This paper explores the effects of caffeine on attitude change by using two types of secondary tasks that manipulate the extent to which people are able to systematically process the message (an orientating task and a distracter task). These secondary tasks consist of a specific activity that participants undertake whilst they read the message. We would expect there to be a reliable interaction between drink consumption (caffeine vs. placebo) and the level of message processing encouraged by the secondary task (reduces vs. increases message processing). When the secondary task reduces participants' ability to process the message, then there should be little or no attitude change irrespective of the consumption of caffeine. In this situation, the potential enhancing effects of caffeine on attitude change is negated by the inhibiting effect the secondary task has upon message elaboration. However, when the secondary task increases message processing, the effect of caffeine on attitude change is through systematic processing (as proposed by Martin et al., 2005), and therefore under conditions that increase systematic processing there should be greater attitude change in the caffeine than the placebo conditions. In other words, the increased systematic processing from the caffeine combined with that from the secondary task should enhance attitude change compared to that achieved via the secondary task alone.

In addition, each experiment introduces an additional technique to examine the nature of the attitude change following caffeine consumption. According to the ELM, attitudes that are formed

via systematic processing are considered to be 'strong' while those formed through non-systematic processing they are considered to be relatively 'weak' (see Krosnick, Boninger, Chuang, Berent & Carnot 1993). We examined the strength of attitudes (strong vs. weak) formed following caffeine consumption on their ability to resist counter-persuasion (Experiment 1) and affect indirect attitudes (Experiment 2). If caffeine increases systematic processing, as we hypothesize, then attitudes formed following caffeine consumption should be more able to resist counter-persuasion and also lead to indirect influence compared to attitudes formed via non-systematic processing.

In summary, there is a large volume of research showing that ingestion of moderate amounts of caffeine increases people's ability to process information, a factor considered crucial in producing attitude change (Perloff & Brock, 1980). If the effect of caffeine on persuasion is due to systematic processing (Martin et al., 2005), then this relationship should be sensitive to tasks that either encourage or discourage systematic message processing. The following two experiments explored these general hypotheses by using different types of secondary tasks - an orientating task (Experiment 1) and a distracter task (Experiment 2).

Experiment 1

The aim of the first experiment was to examine the effect of increasing or decreasing systematic message-directed processing (via an orientating task) on the relationship between caffeine and attitude change following a persuasive message. The orientating task was introduced prior to reading the initial message. Participants were asked to either cross out every letter 'o' in the text (to decrease message processing) or to remember the arguments in the message, as they would be required to recall them at the end of the study (to increase message processing). We hypothesized that the high message processing task would instigate systematic processing of the message, which would result in greater attitude change in the direction of the persuasive message. The consumption of caffeine (vs. placebo) was expected to increase message-congruent thinking and therefore agreement with the message in the high message processing condition. In contrast, the low message

processing task was designed to inhibit systematic processing, and therefore the effects of caffeine were not expected to appear in this condition.

Using a standard attitude-change paradigm, participants consumed a drink containing either caffeine or no caffeine (placebo) 40 minutes prior to reading a persuasive message (which consisted of six persuasive arguments arguing a counter-attitudinal position). After this, participants completed a range of attitude scales to determine whether they had been influenced by the message. Consistent with research examining the ELM, we employed a thought-listing task where participants were asked to list all the thoughts they had had about the topic of the message when they were reading it (Petty & Cacioppo, 1986). This is a commonly used technique to assess the extent to which people engage in message-orientated cognitive elaborations and it is a good predictor of attitude change (Fabrigar, Priester, Petty & Wegener, 1998; Hafer, Reynolds & Obertynski, 1996)).

An additional aspect of this experiment was that participants were exposed to two messages which argued different positions delayed in time (initial and counter-message), with attitude scores taken after each message (e.g., Haugtvedt & Petty, 1992; Haugtvedt & Wegener, 1994; R. Martin, Hewstone & Martin, 2003; Wu & Shaffer, 1987). According to the ELM, systematic processing of a first message provides individuals with arguments to resist the influence of a second counter-message. However, if attitudes to a first message are formed via non-systematic processing, they should be relatively weak and susceptible to the influence of a second counter-message. In short, the extent to which participants are able to resist a second counter-message is an indicator of how much attitudes following the initial message were formed via systematic processing (R. Martin et al., 2003).

Method

Participants and Design

Participants were 72 female students from a university in Australia who took part for partial course credit. Participants were selected on the basis of pre-determined criteria, which stipulated that they

(a) were not on any medication that affects arousal levels, (b) had not experienced any previous contra-indication to caffeine, (c) were non-smokers (or smoked less than five cigarettes per day), (d) were low to moderate coffee drinkers (drank less than 5 cups of coffee per day), and (e) were not pregnant or breastfeeding. Twelve participants were excluded because their pre-test attitude towards the topic of influence was the same as the message (and therefore the message would not have been counter-attitudinal). In a randomised and double-blind procedure, participants were assigned to one of four conditions of a 2 (drink: caffeine vs. placebo) by 2 (message processing: low vs. high) between-subject factorial design with 15 participants per cell.

Procedure

The study took place over two sessions. To reduce expectancy effects, participants were informed that they would be required to consume an orange juice drink that may or may not contain caffeine. All participants were required to abstain from caffeine-containing products and alcohol from 8.30 pm the evening preceding the study, and for a further two hours following completion of the test session (to allow for caffeine metabolism, James, 1991). On the day of the study, they were instructed to eat their usual breakfast and maintain hydration by drinking water or milk.

First Session. During the first session participants completed a number of questionnaires. Participants' pre-test attitudes towards several issues were assessed on 9-point scales ranging from 1, *totally disagree,* to 9, *totally agree*. One of these issues was the target item concerning the use of voluntary euthanasia (i.e., a person's right to terminate their life if they have a terminal illness) and this served as the pre-test. Next, participants estimated their (usual) weekly intake of caffeine containing foods and drinks on a caffeine consumption questionnaire. Items were listed under specific categories (coffee, tea, chocolate products, soft drinks, energy drinks). A daily average of caffeine consumption was derived from the summation of the weekly estimates. Estimates of caffeine content were based on metrically converted standard values (Barone & Roberts, 1984; James, 1991) and metrical standard values. Participants' individual differences in circadian rhythms were assessed via the Morning-Eveningness Questionnaire (MEQ, Horne & Östberg,

1976). The MEQ consists of 19 items which are designed to assess the time of the day an individual feels the most alert, works more efficiently, and how difficult they find getting up in the morning. High scores indicate morning-type individuals who work more efficiently in the morning. Low scores indicate evening-type individuals who work more efficiently in the evening. Finally, participants' weight was measured (without shoes) on weighing scales and recorded (to nearest kilogram). This measurement allowed the experimenter to administer the correct amount of caffeine to those participants assigned to the caffeine condition.

Second Session. The second session took place one week after the first session with participants tested in small groups of four to eight during the morning period (8.30am or 10am). To decrease arousal and distraction, each participant was assigned to an individual desk and instructed not to interact with fellow participants. During this session participants were given one questionnaire at a time, and, once completed, were asked to put it into an envelope and not to look at previously completed ones. The session proceeded with the following stages. First, participants were asked to complete the Breakfast Consumption Questionnaire on which they were asked to write what they had eaten or drank since getting up that morning. Second, each participant consumed 330 mls of a commercially available sweetened orange juice.[2] In a randomised, double-blind procedure, half of the drinks contained anhydrous caffeine at a concentration of 3.5 mgs/kg of body weight and half had nothing added (placebo condition). Participants were asked to drink the juice as quickly as possible. To allow for the maximum absorption of caffeine, participants waited for 40 minutes before continuing with the study. This absorption time interval is optimal for caffeine to peak in the blood (Maisto, Galizio & Connors, 1991; Reynolds, 1996). Third, participants were informed that there was a debate regarding voluntary euthanasia in various communication mediums (such as newspaper, radio, television). As a cover story, they were told prior research had shown that students at their university were divided in their attitudes towards voluntary euthanasia – some were in favour of voluntary euthanasia, whilst others were against. Before participants read the arguments the extent of message-directed processing was manipulated.

In the low message processing condition, participants were asked to go through each word in the message and cross out every letter ‘o’. The aim of this task was to encourage only a superficial consideration of the content of the arguments contained in the message. In the high message processing condition, participants were asked to read the arguments and try to remember them because they would be required to recall them at the end of the study. This latter instruction was designed to encourage systematic processing of the arguments. As a persuasive message, six convincing narrative arguments against voluntary euthanasia were then presented. Such a message has been successfully employed in other studies of attitude change (see Martin & Marrington, 2005; Martin & Martin, in press; R. Martin, Gardikiotis & Hewstone, 2002; R. Martin et al., 2003). Fourth, after reading the message, participants completed a thought-listing task and the same 9-point scale measuring their attitude towards voluntary euthanasia as in the first session (post-test I: initial message). Participants were then asked to recall as many of the arguments in the message as they could. Finally, participants were given six strong arguments that argued the opposite position to the initial message, i.e. pro-voluntary euthanasia. The initial and counter-messages both contained the same number of arguments and were of similar word lengths. The participants then completed the same attitude scale as that following the initial message (post-test II: counter-message). At the end of the study participants were asked to read through the thoughts they had listed following the initial message and to indicate whether they were in favour, against or neutral towards voluntary euthanasia. Finally, participants were thanked for their participation and were debriefed about the aims of the research.

Dependent Measures

Thought-listing task. After participants had finished reading the initial message, they listed the thoughts they had generated while reading the arguments against voluntary euthanasia. They were required to list one thought per box (seven boxes were provided) and to put a different thought in each box (they were instructed that they did not have to fill all the boxes).

Attitude change. Participants completed the same 9-point scale concerning their level of agreement towards voluntary euthanasia before, after initial message and after counter-message.

Argument recall. Participants were asked to recall the arguments they had read in the initial message, and were told that it didn't matter if the arguments weren't recalled exactly, but just to recall as many as possible, listing each one on a new line.

Caffeine identification. Participants were then asked 'do you believe you were given caffeine?' (yes or no) and asked to rate the confidence in their decision on a scale ranging from 1, *very unconfident* to 5, *very confident*.

Results

Unless noted otherwise, responses to all measures were analysed using a 2 (drink: caffeine vs. placebo) X 2 (message processing: low vs. high) between-subjects analysis of variance (ANOVA). Means and standard deviations for all the dependent variables as a function of drink and message processing conditions are shown in Table 1.

Preliminary Analyses

Participant allocation. To ensure that participant allocation to the experimental cells was random, preliminary analyses were conducted. An ANOVA revealed no significant main effects or interactions between the independent variables for pre-test attitudes towards voluntary euthanasia, habitual daily caffeine intake, age, weight, and morningness-eveningness.

Drink identification check. There was no difference in the number of people who believed their drink contained caffeine to those that did not, in the caffeine (14 vs. 16) and placebo (11 vs. 19) conditions, chi square (1) < 1. The ANOVA revealed no significant effects of confidence in drink identification. The pattern of results for the main dependent variables (attitudes and message congruent-thoughts) was not affected by the inclusion of drink identification and confidence in drink identification as covariates.

Argument recall. The ANOVA for the number of initial message arguments recalled showed two reliable main effects. First, participants in the caffeine condition recalled a

significantly greater number of arguments ($M = 3.77$) than participants in the placebo condition ($M = 3.03$), $F(1, 56) = 4.67$, $p < .05$. Second, participants in the high message processing condition recalled significantly more arguments ($M = 3.97$) than participants in the low message processing condition ($M = 2.83$), $F(1, 56) = 11.16$, $p < .001$. The latter finding is particularly important as it shows that the message processing variable had been successful in varying the extent to which people attended to the content of the message.

Habitual caffeine consumption and withdrawal effects. The daily caffeine consumption scores of participants were classified within each drink condition into low (< 110 mg/day) and moderate levels (>111 mg/day), with 15 participants per cell. The ANOVA showed no reliable main effects or interactions on any of the dependent variables.

Main Analyses

Attitude change. The attitude measure was reverse coded such that higher scores represented greater agreement with the persuasive message. The attitude scores were analyzed by a 2 (drink: caffeine vs. placebo) X 2 (message processing: low vs. high) X 3 (measurement time: pre-test vs. post-test I: initial message vs. post-test II: counter-message) mixed model analysis of variance (ANOVA) with the last factor being repeated measures. The ANOVA revealed main effects of drink, $F(1,56) = 4.60$, $p < .04$ and measurement time, $F(2,112) = 25.62$, $p < .001$, and interactions of drink X measurement time, $F(2,112) = 5.36$, $p < .007$, message processing X measurement time, $F(2,112) = 7.23$, $p < .001$, and drink X message processing X measurement time, $F(2,112) = 3.13$, $p < .05$.

Analysis of simple main effects showed that participants did not change their attitude towards the messages when message processing was low in either the placebo (*Ms* = 2.47 vs. 3.00 vs. 3.00), $F(2, 112) = 1.17$, *n.s.*, or caffeine (*Ms* = 2.67 vs. 3.33 vs. 3.53), $F(1,56) = 2.53$, *n.s.*, conditions. However, participants did change their attitude towards the messages when message processing was high in both the placebo, $F(2,112) = 5.93$, $p < .004$, and caffeine $F(2,112) = 31.75$, $p < .001$, conditions.

Focusing first on attitude change to the initial message (pre- vs. post-test I), there was a reliable change in attitude towards the initial message when message processing was high in both the placebo (*Ms* = 2.40 vs. 3.73), $F(1,56) = 13.18$, $p < .001$, and caffeine (*Ms* = 2.40 vs. 5.33), $F(1,56) = 63.77$, $p < .001$, conditions. However, the amount of attitude change in the caffeine condition ($M_{difference} = 2.93$) was reliably larger than that in the placebo condition ($M_{difference} = 1.33$), $F(1,56) = 19.04$, $p < .001$.

Focusing on attitude change to the counter-message (post-test I vs. post-test II), in the placebo condition the reliable change in attitude to the initial message (*Ms* = 2.40 vs. 3.73), *yielded* to the second counter-message (*Ms* = 3.73 vs. 2.73), $t(56) = 5.19$, $p < .03$. Indeed, there was no reliable difference between pre-test and post-test II showing attitudes had returned to their original level (*Ms* = 2.40 vs. 2.73) $t(56) = .69$, *n.s*. However, in the caffeine condition the reliable change in attitude to the initial message (*Ms* = 2.40 vs. 5.33), *resisted* the second counter-message (*Ms* = 5.33 vs. 5.00), $t(56) = .58$, *n.s*. The difference between the pre- and post-test II attitude scores (*Ms* = 2.40 vs. 5.00) was reliable, $t(56) = 42.25$, $p < .001$.

Message-congruent thoughts. A thought index was computed by dividing the number of anti-voluntary euthanasia thoughts with the number of pro- and anti-voluntary euthanasia thoughts. Higher scores indicated a higher ratio of message-congruent thinking. Two significant main effects were found. Participants in the caffeine condition generated a higher ratio of message-congruent thoughts ($M = 0.59$) than did those in the placebo condition ($M = 0.32$), $F(1, 56) = 9.03$, $p < .005$. Also, participants in the high message processing condition generated a higher ratio of message-congruent thoughts ($M = 0.56$) than participants in the low message processing condition ($M = 0.36$), $F(1, 56) = 5.18$, $p < .03$.

Mediation analysis. To explore further the processes that determine attitude change we conducted a mediation analysis (see Baron & Kenny, 1986). We did this in the high message processing condition to test the hypothesis that caffeine increases attitude change via increased message elaboration. Since there was a reliable difference between drink conditions for both the

ratio of message-congruent thoughts and arguments recalled, we conducted separate mediation analyses for each of these (note, the intercorrelation was not reliable, $r(30) = .23$, *n.s.*). In all the analyses we included pre-test scores to control for initial differences in attitudes. The conditions for mediation were met for message-congruent thoughts. Drink condition (caffeine vs. placebo) predicted the ratio of message-congruent thoughts ($\beta = .408$, $p < .007$). Once controlling for drink condition, the ratio of message-congruent thoughts predicted the amount of attitude change ($\beta = .703$, $p < .002$). Finally, the once significant relationship between drink condition and attitude change ($\beta = .443$, $p < .02$) became nonsignificant when controlling for the ratio of message-congruent thoughts ($\beta = .156$, *n.s.*). The reduction in beta weights was reliable (Sobel test, 1982, $t = 2.23$, $p < .03$). However, the conditions for mediation were not met with the number of arguments recalled. The significant relationship between drink condition and attitude change ($\beta = .443$, $p < .02$) did not reduce in significance when controlling for the number of recalled arguments ($\beta = .438$, $p < .03$).

Summary

The results indicate that moderate doses of caffeine can lead to greater agreement with a persuasive message but only when the orientating task encourages message processing. When the orientating task reduced participants' ability to process the message, there was no attitude change irrespective of whether they had consumed caffeine. Most importantly, there was greater attitude change in the high message processing condition for those in the caffeine compared to the placebo condition, and this change in attitude resisted the counter-message while the latter yielded to it. This shows that caffeine increased message processing (and attitude change) in addition to the increase that was instigated by the high message processing task alone. The mediation analysis further supports this finding. One methodological issue is worth noting. The nature of the orientating task does not rule out the possibility that participants' could have engaged in some message processing in the low message processing condition. The low message processing condition involved a task where participants crossed out all the 'o's in the message and was designed to reduce the extent to

which they could read, and process, the content of the message. However, it is possible that the nature of the task did not deplete participants' cognitive resources sufficiently to render them unable to attend to the content of the message. This is shown in the message recall data where participants in the low message processing condition recalled, on average, 2.83 out of six arguments. In our second experiment, we employ a different methodology to reliably reduce participants' ability to process the message.

Experiment 2

The aim of the second experiment was to further explore how caffeine affects persuasion in situations where people's ability to process the message has been decreased. More specifically, we addressed the potential methodological issue raised in Experiment 1 by ensuring participants in the low message processing condition could not, in fact, systematically process the message. It is possible that participants in the low message processing condition (where they crossed out the o's) could still process the message. To overcome this issue we used a distracter paradigm where participants were required to respond to a secondary task whilst reading the message (see Harkins & Petty, 1992). By varying the difficulty of the secondary task, we were able to create conditions that were either low or high in distraction. Specifically we ensured that in the high distraction condition the demands of the secondary task were such that participants would be unable to attend to the content of the message.

The materials and procedure were similar to those used in Experiment 1 and two levels of distraction were used (low vs. high). We introduced two new dependent measures to give a more detailed understanding of the impact of caffeine on attitudes. First, we measured attitudes using a 4-item 9-point semantic differential scale (rather than the 1-item scale employed in Experiment 1) to provide a psychometrically better measure. Second, we included an indirect attitude measure. Indirect attitudes are ones that are logically related to the main issue but are not mentioned in the content of the message (see Alvaro & Crano, 1997). If people's attitudes are influenced via systematic processing then one would expect attitude change to generalise to related/indirect

attitudes (even if they had not been mentioned by the source). Our hypotheses were similar to those stated in Experiment 1. When distraction is low, those consuming caffeine should show greater attitude change than those in the placebo condition. When distraction is high (and so systematic message processing is not possible), then there should be no difference between the drink conditions.

Method

Participants and Design

The participants were 76 male students from a university in Australia taking part for partial course credit. The study employed the same pre-determined selection criteria as used in Experiment 1. Participants were only included in the final sample if their pre-test scores indicated that they agreed with both the direct and indirect attitudes (to ensure that the message was counter-attitudinal), and if they successfully completed the distracter task. The final sample comprised of 60 participants who were assigned to one of four conditions of a 2 (drink: caffeine vs. placebo) X 2 (distracter task: low vs. high) factorial design. In a randomised and double-blind procedure, participants were allocated to one of four conditions: caffeine/low distracter task (n = 16), caffeine/high distracter task (n = 16), placebo/low distracter task (n = 13), placebo/high distracter task (n = 15).

Procedure

The procedure was the same as for Experiment 1 except for the following differences. First, identical pre- and post-test semantic differential scales were used to examine attitude change. Second, we included an indirect measure of the main attitude. The topic of abortion was chosen as an indirect attitude of the message topic (voluntary euthanasia). Both abortion and voluntary euthanasia share some common conceptual issues in that they are both acts of controlling life. In this study there was a positive correlation between the pre-test attitudes of abortion and voluntary euthanasia, $r(60) = .32$, $p < .02$. The voluntary euthanasia message did not contain any reference to the issue of abortion.

As with Experiment 1, the same six high quality arguments against voluntary euthanasia were presented. Participants were given two minutes to read the arguments whilst performing either a low or high distracter task. The secondary task involved participants pressing a thumb counter in response to hearing specific sounds that were delivered via headphones. The level of distraction was manipulated by varying the frequency and complexity of the target sounds to be identified. In the low distracter task condition, participants were given the following instructions while reading the arguments: "please listen through your headphones to the tape recording, and count the number of times you hear a sound by pressing on the thumb counter" (12 in total). In the high distracter condition participants were required to press a thumb counter only when they heard a high pitched sound (56 in total), and were required to ignore two lower pitched sounds. A pre-determined selection criterion ensured that only participants who gave the correct number of clicks (+/- 2 clicks) for each distracter condition were used in the final analyses.

Dependent Measures

The *breakfast questionnaire, caffeine consumption questionnaire, morning-eveningness questionnaire, thought listing task, message-recall task* were the same as those employed in Experiment 1. Both pre- and post-test direct and indirect attitudes were measured on the same four 9-point semantic-differential scales. The ends of the four scales were anchored; *good-bad, unfavourable-favourable, foolish-wise*, and *harmful-beneficial* (αs for pre- and post-test direct attitudes were .79 and .81 respectively and indirect attitudes were 89 and .85 respectively).

Drink Administration. 480 ml of cooled sweetened bottled orange juice was used in the present experiment, after a pilot study of males weighing between 70 and 93 kgs deemed that this quantity was necessary to disguise the bitter taste of caffeine at a dose of 3.5 mg/kg of body weight. The *caffeine identification measure* was similar to Experiment 1 but also incorporated an additional response of 'don't know.'

Results

Unless noted otherwise, all analyses were conducted using a 2 (drink: caffeine vs. placebo) X 2 (distracter task: low vs. high) analysis of variance. Means and standard deviations for all the dependent variables as a function of drink and distracter task conditions are shown in Table 2.

Preliminary Analyses

Participant allocation. The analyses of variance showed no significant main effects or interactions between the independent variables and pre-test attitudes towards voluntary euthanasia, abortion, habitual daily caffeine intake, age, weight, and morningness-eveningness.

Drink identification check. There was no difference in the number of people who believed their drink contained caffeine and those that believed it did not or did not know, in the caffeine (12 vs. 9 vs. 3) and placebo (7 vs.15 vs. 6) conditions, χ^2 (2) = 4.04. The ANOVA revealed no significant effects of confidence in drink identification. As for Experiment 1, the pattern of results for the main dependent variables (direct and indirect attitudes and message congruent-thoughts) was not affected by the inclusion of drink identification and confidence in drink identification as covariates.

Argument recall. The ANOVA showed a reliable main effect for distracter task, $F(1, 56) = 53.09$, $p < .001$, and a drink X distracter task interaction, $F(1, 56) = 5.62$, $p < .02$. Simple main effects showed that those in the high distraction condition recalled fewer message arguments than those in the low distraction condition in both the caffeine condition, $F(1, 56) = 50.09$, $p < .001$, (Ms = 0.81 vs. 3.25) and placebo condition, $F(1,56) = 11.82$, $p < .001$, (Ms = 1.07 vs. 2.31). This shows that the distracter was successful in altering the extent to which participants were able to focus on the content of the message. Finally, only in the low distraction condition, did those in the caffeine condition (M = 3.25) recall more than those in the placebo condition (M = 2.31), $F(1,56) = 9.88$, $p < .004$.

Habitual caffeine consumption and withdrawal. The median daily caffeine consumption scores were classified into low (< 107 mg/day) and moderate levels (> 108 mg/day). The numbers

in each cell were as follows: caffeine low, $n = 13$ and high $n = 19$ vs. placebo low, $n = 17$ and high $n = 11$. The ANOVA showed no reliable main effects or interactions on any of the dependent variables.

Main Analyses

Direct attitude change (voluntary euthanasia). The four-item scale was reverse coded so that higher scores indicated greater agreement with the message. The attitude scores were analysed by a 2 (drink: caffeine vs. placebo) X 2 (distracter task: low vs. high) X 2 (measurement time: pre- vs. post-test) ANOVA with repeated measures on the last factor. The ANOVA revealed a significant distracter task X measurement time interaction, $F(1,56) = 13.14$, $p < .002$, showing that only the low distracter task condition resulted in greater agreement towards the arguments (pre- and post-test attitudes: low distracter *Ms* = 3.61 vs. 4.60 and high distracter task *Ms* = 3.79 vs. 3.92). The three-way interaction also reached significance $F(1,56) = 4.21$, $p < .05$. Simple main effects revealed no significant change in attitudes over time with high distraction for both the caffeine $F(1,56) = .13$, *n.s.* and placebo $F(1,56) = .66$, *n.s.* conditions (pre- and post-test attitudes for caffeine and placebo: *Ms* 3.98 vs. 4.06 and 3.58 vs. 3.77 respectively). By contrast, with a low distracter task, both the caffeine $F(1,56) = 38.96$, $p < .001$ and the placebo recipients $F(1,56) = 4.97$, $p < .04$, showed a change in attitude towards the message, (caffeine: *Ms* = 3.61 vs. 4.97 and placebo *Ms* = 3.62 vs. 4.15 respectively). However, the attitude change in the caffeine condition ($M_{change} = 1.36$) was greater than that in the placebo condition ($M_{change} = 0.53$), $F(2,56) = 21.96$, $p < .001$).

Indirect attitude change (abortion). The four-item scale was reverse coded such that higher scores indicated greater agreement with the message. The attitude scores were analysed by a 2 (drink: caffeine vs. placebo) X 2 (distracter task: low vs. high) X 2 (measurement time: pre- vs. post-test) ANOVA with repeated measures on the last factor. The main effect for measurement time and the interaction effects for distracter task X measurement time and drink X distracter task were all significant, ($F(1, 56) = 21.56$, $p < .01$; $F(1, 56) = 6.69$, $p < .05$; $F(1, 56) = 3.95$, $p < .05$).[3]

Further analyses showed that only those participants in the caffeine condition, when there was low distraction, showed more agreement with the message over measurement time, $F(1,56) = 28.94$, $p < .001$ (*Ms* = 3.79 vs. 4.92). There were no reliable changes over measurement time for those in the caffeine/high distracter task, $F(1,56) = 3.63$, *n.s.* nor for either distracter task in the placebo conditions (both $F(1,56) < 1$, *n.s.*).

Message-congruent thoughts. A thought index was created in the same way as for Experiment 1, with high scores indicating a higher ratio of message-congruent thinking. The ANOVA revealed a reliable main effect of distracter task, $F(1, 56) = 5.17$, $p < .03$, and a distracter task X drink condition, $F(1, 56) = 3.95$, $p < .05$. Simple main effects revealed that for the caffeine condition, participants gave a higher ratio of message-congruent thoughts in the low distracter ($M = 0.69$) than the high distracter ($M = 0.30$) conditions, $F(1, 56) = 4.13$, $p < .03$. There was no effect of task condition for those in the placebo condition, $F(1, 56) = .98$, *n.s.*. As expected, with a high distracter task, there was no difference in the thoughts ratio for those in the caffeine ($M = 0.30$) and placebo ($M = 0.42$) conditions, $F(1,56) = .05$. Finally, with a low distracter task, those in the caffeine condition ($M = 0.69$) gave a greater proportion of message-congruent thoughts than did those in the placebo condition (0.45), $F(1,56) = 9.76$, $p < .004$.

Mediation analysis. In order to further explore the relationship between thought elaboration and direct attitude change a mediation analysis was conducted. To do this we dummy coded the drink X distracter task interaction as follows; low distracter/caffeine (1), low distracter/placebo (-1), high distracter/caffeine (-1), high distracter/placebo (1) respectively. A direct attitude change score (post-test minus pre-test attitude) was used for the dependent variable. In all analyses the pre-test direct attitude score was also entered into the equation to control for initial differences in attitudes. The drink X distracter task interaction predicted the ratio of message-congruent thoughts ($\beta = .267$, $p < .04$) which itself predicted the direct attitude change score, when controlling for the interaction ($\beta = .477$, $p < .0001$). The significant relationship between the drink X distracter task interaction and direct attitude change score ($\beta = .230$, $p < .05$) became nonsignificant when controlling for the

ratio of message-congruent thoughts (β = .102, n.s.). The reduction in beta weights was significant (Sobel test, 1982, t = 1.98, p < .05). These results showed that the proportion of message-congruent thinking mediated the relationship between the drink X distracter interaction and the amount of direct attitude change.

Summary

The results for the second experiment confirmed our predictions. When distraction was low, caffeine led to greater attitude change and higher argument recall compared to the placebo condition (replicating Experiment 1). When distraction was high, and participants were unable to systematically process the message, there was no reliable change towards the message's position for either the caffeine or placebo conditions. In addition, those in the caffeine/low distraction condition showed greater agreement with the indirect item showing more 'deeper' and enduring attitude change. Like Experiment 1, the proportion of message-congruent thinking mediated direct attitude change providing further evidence that caffeine induces systematic processing of the message.

General Discussion

This paper reports one of the few attempts to examine the effects of caffeine on persuasion. In the introduction we cited evidence that moderate amounts of caffeine can improve a number of aspects of information processing (such as, attention, reasoning and memory recall) which have been implicated in the process of persuasion. We hypothesized that caffeine consumption should increase the extent to which people will attend to and process a persuasive message and consequently be influenced by it.

We examined these issues in two experiments where 40 minutes after the consumption of a drink that either contained caffeine or did not (placebo), participants read a persuasive counter-attitudinal message whilst completing a secondary task that was designed to affect the extent to which they could process the message. In the first experiment we used orientating tasks that were designed to manipulate the extent to which participants' could systematically process the message. We found the predicted interaction. When message processing was reduced, there was no attitude

change irrespective of whether the participants had consumed caffeine. The potential for caffeine to increase message processing, as found in previous research (Martin et al. 2005; Martin & Martin, in press), was negated by the inhibiting effect of the orientating task. When message processing was increased, there was greater attitude change in the caffeine compared to the placebo condition. This effect was mediated by the extent to which participants engaged in message-congruent thinking.

We introduced a novel aspect to the first experiment to examine the strength of the attitudes formed after reading the initial message. Research utilizing the ELM has shown that when attitudes are formed via systematic processing they are 'strong' and therefore they are able to resist counter-persuasion, persist over time and be predictive of behaviour. Experiment 1 examined this in relation to resisting counter-persuasion. To examine this we exposed participants to a second message that argued a position against the initial message. We found that the attitude change observed in the high processing condition resisted the counter-message when participants had consumed caffeine (indicating that initial attitude change had been via systematic processing) but yielded to the counter-message when participants were in the placebo condition. This gives further evidence that caffeine led to attitude change to the first message by encouraging participants to systematically process the message. It must be noted, however, that the message employed in this experiment consisted of high quality arguments concerning a topic that would not be considered to be high in personal relevance to the participants. According to the ELM, the relationship between systematic processing and persuasion/resistance is critically dependent on the content and quality of the message. When people engage in systematic processing they are more likely to appreciate the strength of a high quality message and recognise the weakness inherent in a low quality message. Hence following caffeine consumption, a high (but not a low) quality message should result in attitude change in the direction of the message (Martin et al., 2005), and these newly formed attitudes are expected to be 'strong' and therefore they should persist over time and be predictive of behaviour.

The second experiment, overcame a potential methodological problem associated with the first experiment by using a distracter task that was designed to impair participants' ability to attend to the content of the message.[4] Again, we found the predicted interaction. In the high distraction condition, where participants' ability to process the message systematically was reduced (a situation akin to the 'low message processing' condition in Experiment 1), there was no attitude change irrespective of drink condition. This replicates Experiment 1. However, in the low distraction condition, where participants could systematically process the message, there was greater attitude change in the caffeine condition. The fact that the level of message-congruent thinking mediated these effects is further evidence that caffeine increases attitude change by instigating systematic processing of the message.

An interesting feature of Experiment 2 was the inclusion of an indirect attitude measure, that is, an issue related to the direct attitude but not mentioned in the message. If people are persuaded by a message, then it is possible that the change in attitudes will have a 'knock-on' effect to other attitudes even though they might not have been part of the original message. Change on indirect attitudes is considered to reflect a deep and long-lasting change in attitudes (see Alvaro & Crano, 1997). In Experiment 2, there was no indirect attitude change in the placebo conditions – showing that the message was not sufficiently strong to induce changes on indirect or related attitudes. However, in the caffeine/low distracter condition, there was a reliable change in indirect attitudes showing that caffeine increased message processing which resulted in attitude change to the direct attitude also impacting upon an indirect attitude. As expected, there was no change in the caffeine/high distraction condition presumably because participants were unable to engage in detailed message processing.

The results of these studies support the view that caffeine increases persuasion through instigating systematic processing of the message. However, a rival explanation might be that the effects of caffeine occur because the drug increases emotional arousal (Mintz & Mills, 1971), and/or improves mood. It is well known that people who are in a positive mood are more likely to

agree with a message compared to those in a negative mood (see footnote[1]). If this is the case, then attitudes may change via a non-systematic route where people have not attended closely to the content of the message. The results of both experiments do not support this rival hypothesis. If persuasion had been due to enhanced mood, then attitude change should have occurred irrespective of whether the participants' ability to process the message had been reduced, and this attitude change should have yielded to the counter-message (Experiment 1) and had no impact on indirect influence (Experiment 2). Although mood cannot explain the results in these experiments, we believe it would be a fruitful avenue for future research, especially given that the effects of caffeine on mood are dose-dependent (Smith, Tola & Mann, 1999).

Studies involving caffeine consumption are open to a variety of methodological issues that can affect observations. Other than the factors already mentioned (e.g., double-blind caffeine administration), we attempted to control for many variables that have been found to interact with caffeine, such as time of day (Anderson & Revelle, 1994; Revelle, Humphreys, Simon & Gilliland, 1980), gender (MacPherson, Sternhagen, Miller, Devitt, Petros & Beckwith, 1996; Smith, Kendrick & Maben, 1992), age (Jarvis, 1993; Rogers & Dernoncourt, 1998; Smit & Rogers, 2000), morning evening types (Horn & Őstberg, 1976), and habitual caffeine consumption (Roblin & Rogers, 1998). The rigorous methodology we applied, combined with the consistent results across the studies, increases our confidence in the findings.

Our results are consistent with the hypothesis that moderate amounts of caffeine increase central route processing (Martin et al., 2005). However, further research needs to more clearly establish the conditions under which caffeine leads to persuasion through the central (systematic) or peripheral (non-systematic) route and the mediating processes. Research on the ELM has identified several manipulations for identifying whether persuasion has occurred through the central or peripheral route (such as, source status, peripheral cues, argument quality and, motivational and ability variables, Petty & Cacioppo, 1986; Petty et al., 1994). Furthermore, we believe that these studies need to also include appropriate measures of both self-report (such as, mood inventories)

and objective (such as, GSR, blood pressure) measures of physiological arousal to provide a more detailed understanding of the relationship between caffeine and persuasion. Finally, if one considers the frequency with which caffeine-containing products are consumed, coupled with the strong social norms of linking caffeine consumption with situations that could involve the processing of persuasive communications (such as, drinking coffee whilst reading a newspaper or watching TV advertisements), the practical implications of our findings to 'real world' settings are many and therefore warrant future investigation.

Footnotes

[1] It is also possible that caffeine might increase persuasion due to the association between caffeine consumption and mood. Caffeine-induced changes in subjective mood include findings showing increased alertness and decreased fatigue (Herz, 1999; Leathwood & Pollet, 1983; Quinlan, Lane & Aspinall, 1997; Schuh & Griffiths, 1997; Smit & Rogers, 2000) and increased happiness, well-being, and/or calmness (Lieberman, Wurtman, Emde, Roberts, & Coviella, 1987; Warburton, 1995; Zwyghuizen-Doorenbos, Roehrs, Lipschutz, Timms, & Roth, 1990). However, negative effects have also been reported, such as increased jitteriness, anxiety, shakiness, and tension (Richardson, Rodgers, Elliman & O'Dell, 1995; Evans & Griffiths, 1999; Schuh & Griffiths, 1997). Although, as Lieberman (1992) notes, "adverse behavioural effects occur when caffeine is consumed in excessive doses or by individuals who are overly sensitive to the substance". In addition, some studies show that caffeine increases self-reported arousal compared to a placebo condition, but this was a general effect and not effected by other independent variables (Martin et al., 2005). Since the results of previous studies indicate that moderate doses of caffeine increase attention to the message, and the inconsistent findings concerning caffeine and mood, we did not explore this aspect in this paper. However, we acknowledge that enhanced mood (and physiological arousal) may play a role in the persuasion process and this warrants further examination.

[2] The study used sweetened orange juice (rather than caffeinated or decaffeinated coffee/ tea) for both caffeine and placebo recipients, to mask the bitter taste of caffeine and to control for expectancy effects related to coffee and tea.

[3] A similar pattern of results was found when controlling for the direct attitude (voluntary euthanasia) ruling out response generalisation as an explanation for the findings.

[4] This was achieved with the manipulations employed in the second experiment because those in the high distracter condition recalled, on average, only 0.81 arguments while in the low message processing condition in the first experiment they recalled 2.83 arguments.

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Table 1: Means and standard deviations for the dependent measures as a function of drink and message processing conditions (Experiment 1).

	Drink Condition			
	Caffeine		Placebo	
	Message Processing			
	High (n = 15)	Low (n = 15)	High (n = 15)	Low (n = 15)
Attitude				
Pre-test	2.40	2.67	2.40	2.47
SD	(1.06)	(1.35)	(1.81)	(1.46)
Post-test I: Initial	5.33	3.33	3.73	3.00
Message	(1.92)	(1.11)	(2.74)	(1.51)
SD				
Post-test II:				
Counter- Message	5.00	3.53	2.73	3.00
SD	(2.24)	(1.46)	(1.83)	(1.65)
Ratio of message-				
congruent thoughts	.71	.46	.39	.25
SD	(.29)	(.32)	(.43)	(.31)

Table 2: Means and standard deviations for the dependent measures as a function of drink and distraction conditions (Experiment 2).

	Drink Condition			
	Caffeine		Placebo	
	Distracter Task			
	Low	High	Low	High
	(*n* = 16)	(*n* = 16)	(*n* = 13)	(*n* = 15)
Direct attitude				
Pre-test	3.61	3.98	3.62	3.58
SD	(1.13)	(1.51)	(0.84)	(1.42)
Post-test	4.97	4.06	4.15	3.77
SD	(1.35)	(1.32)	(0.79)	(1.49)
Indirect attitude				
Pre-test	3.79	4.03	3.54	4.68
SD	(1.07)	(1.43)	(2.02)	(1.54)
Post-test	4.92	4.34	3.98	4.82
SD	(1.09)	(1.60)	(1.78)	(1.64)
Ratio of message-congruent thoughts	.69	.30	.45	.42
SD	(.31)	(.37)	(.42)	(.33)